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FOLLOWING THE FATE OF FLOOD LAYERS ON THE NORTHERN CALIFORNIA CONTINENTAL MARGIN

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LONG-TERM GOAL

The long-term goal of this research is to contribute toward our understanding of the processes by which strata are formed on continental margins. In particular, this research is aimed at elucidating the processes that control the distribution, characteristics, and modification of event layers on continental shelves.

SCIENTIFIC OBJECTIVES

The 1995 and 1997 floods of the Eel River in northern California provided a unique opportunity to study the emplacement of event layers on a continental margin and to monitor their modification en route to burial. Objectives of this study were to map the distribution and characteristics of the flood layers on the continental shelf and to document changes over time scales of months to years.

APPROACH

As a part of the STRATAFORM program, my students and I participated in 3 research cruises on the Eel River shelf in FY97. Seabed samples were collected in box, kasten , and piston cores during these cruises, as well as during 7 cruises during FY95 and 96. The cores were dissected at 1-2 cm increments and samples were frozen at sea. Terrestrial carbon in the samples was used to trace the fate of riverine sediment on the continental shelf. Carbon isotopic ratios, C/N, and percent discrete vascular plant debris were measured. Data on sand, silt, and clay content were collected simultaneously.

WORK COMPLETED

Maps of the carbon content, carbon isotopic composition, and concentration of plant debris in surface sediments on the Eel River shelf in February, May, and September of 1995, March 1996, and February 1997 were completed. Vertical trends over time in these parameters and in grain size were examined in the upper 10-15 cm of the seabed at a number of sites. The longer term history of flood layer preservation on the shelf was examined in five kasten cores, from about one to three meters in length.

RESULTS

Carbon isotopic ratios served as very useful tracers of the distribution of the flood layer on the shelf throughout the two years following the 1995 flood of the Eel River, even after biological mixing made the layer very difficult to identify visually or in x-radiographs. Mapping of isotopic values on the shelf during this time interval provided evidence for seaward transport of the flood material as well as for physical and biological mixing of the layer with non-flood sediments, particulary at the deposit fringes. Study of the distribution of vascular plant debris on the shelf similarly provided evidence for substantial offshore sediment transport of the riverine material in the months following the flood event. Investigation of the organic carbon associated with the 1997 flood deposit indicated that physical mixing with ambient shelf sediments was less important during initial emplacement of the 1997 layer than during emplacement of the 1995 layer.

Detailed examination of grain size and organic carbon in the upper meters of the seabed on the middle Eel River shelf indicates that depositional patterns in the past three decades are very different than they were during the previous hundreds of years. The more recent deposits are finer grained and contain at least six flood layers, attributable to known events. Although earlier floods are known to have occurred, their deposits are not identifiable on the middle shelf. This shift is likely the result of changes in the Eel River and its sediment load and consequent increases in sediment accumulation rates on the middle shelf in the 1960's. Intensification of logging in the Eel River drainage basin beginning in the 1950's and an extreme flood in 1964 probably precipitated these changes.

IMPACT/APPLICATONS

Collaborative investigation of the 1995 flood layer in the 2 years following its emplacement on the shelf has provided the most detailed information about the fate of riverine material and development of fine scale stratigraphy on continental margins yet available. The use of organic carbon as a tracer in these detailed studies in similarly unique, and is of much interest to scientists concerned with the fate of terrestrial carbon in the marine environment. The finding that sedimentation and event layer stratigraphy on the Eel River shelf has been different in the past 3 decades than previously points to the sensitivity of shelf sediment accumulation to extreme events, and suggests that extrapolation of current depositional patterns to longer time scales must be done with caution.

RELATED PROJECTS

A proposal to investigate organic carbon/particle dynamics in the Eel River and on the adjacent shelf has been submitted to the American Chemical Society Petroleum Research Fund. A related proposal to NSF is in preparation.